

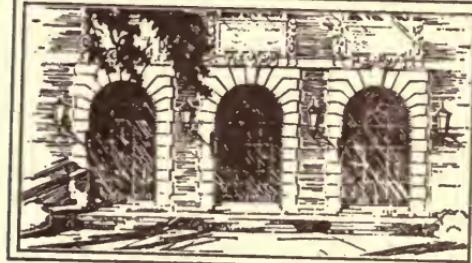
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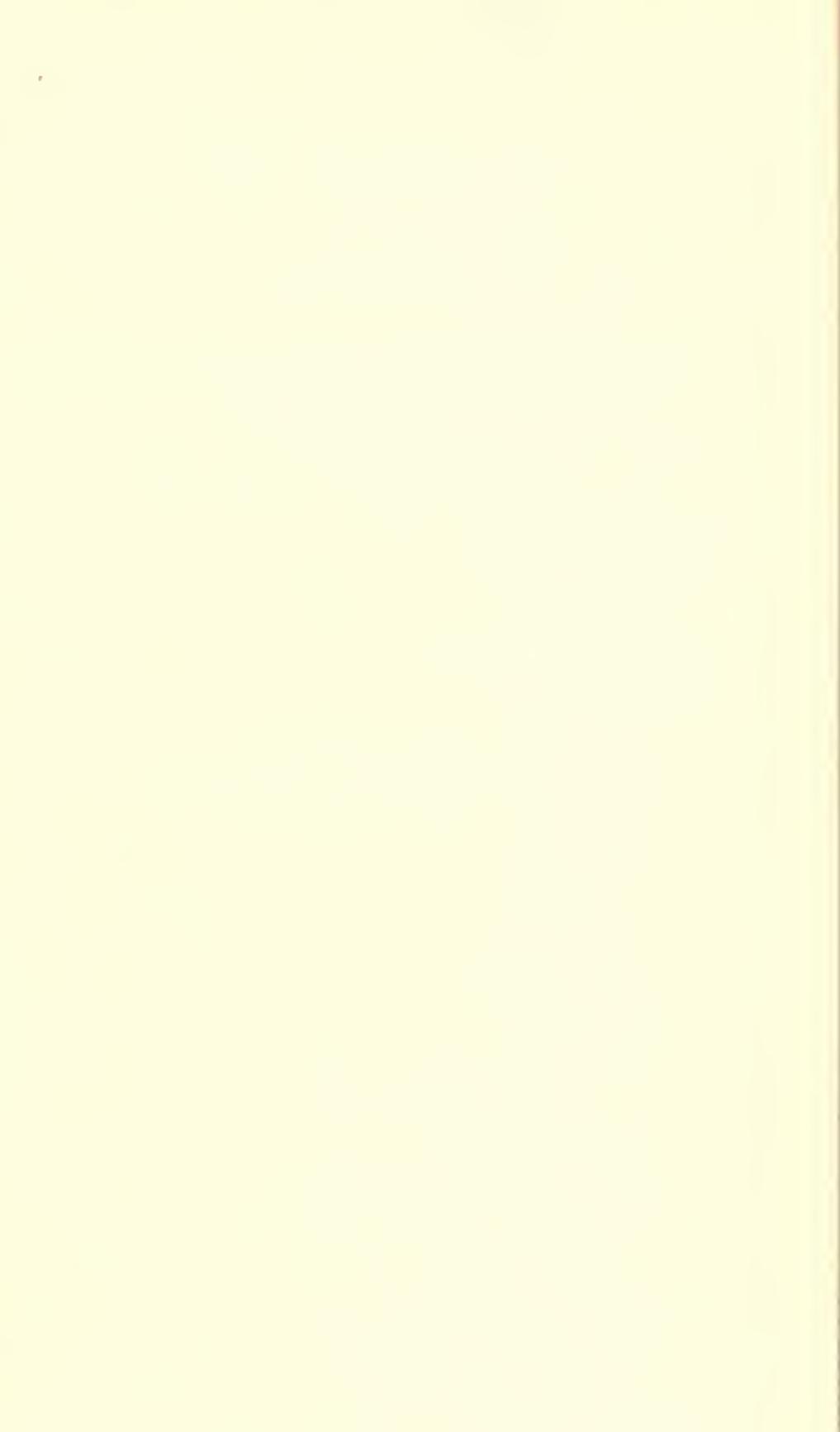
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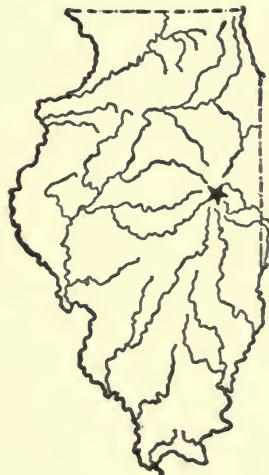


UNIVERSITY OF ILLINOIS
Agricultural Experiment Station

BULLETIN No. 344

GROWING POTATOES IN ILLINOIS

By J. J. PIEPER, W. L. BURLISON,
and W. P. FLINT



URBANA, ILLINOIS, APRIL, 1930

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GROWING POTATOES IN ILLINOIS

By J. J. PIEPER, W. L. BURLISON AND W. P. FLINT¹

MANY new problems have confronted the grower of potatoes during the last decade. Besides those connected with seed, soil, and climate, insects and diseases have become so serious as to make potato growing an unsuccessful venture except where proper spraying is practiced. The acre yields in the state of Illinois for many years have been low. This discouraging fact has led to a material reduction in the number of acres planted and a corresponding decrease in total production. The value per acre, however, shows an upward trend.

Potato growing in Illinois is concentrated in the three northern tiers of counties and in three counties near St. Louis (Fig. 1). The state imports, on the average, nearly 20 million bushels of potatoes annually. The average yearly production for the five years 1925 to 1929 was 5,548,240 bushels (Table 1), while the total estimated yearly consumption is over 25 million bushels. Thus only about one-fourth of the potatoes consumed in Illinois are grown within the borders of the state. There are no regions in which a surplus of potatoes is produced. The areas of greatest deficiency are usually near the centers of population and in the regions of low production. Most of the potatoes imported into Illinois come from states directly to the north, but practically every potato region in the United States contributes to the supply.

With improved cultural practices, Illinois could grow a larger proportion of the potatoes consumed in the state. The object of this bulletin is to set forth certain facts about potato growing and to suggest practices which if adopted should increase the yields of potatoes in Illinois and make them a more profitable crop.

GENERAL REQUIREMENTS FOR GOOD YIELDS

Climatic Requirements

The potato is a cool weather crop, both quality and quantity being adversely affected by high temperatures. From a climatic point of view Illinois is not ideally located for the production of potatoes. The summers are too hot for best results and it is only by taking advantage of the cooler parts of the growing seasons that potatoes can be produced profitably. Early potatoes are planted as soon as possible in the spring in order that they may mature before the ex-

¹J. J. PIEPER, Assistant Chief in Crop Production; W. L. BURLISON, Chief in Crop Production; W. P. FLINT, Chief Entomologist, Illinois Natural History Survey.

TABLE 1.—POTATOES IN ILLINOIS: ACREAGE, PRODUCTION, YIELD, PRICE, AND VALUE BY FIVE-YEAR PERIODS, 1900 TO 1929¹

Year	Acres	Total production	Yield per acre	Price per bushel Dec. 1	Value per acre based on Dec. 1 price
		bu.	bu.		
1900.....	166 262	15 296 104	92	\$.41	\$37.72
1901.....	142 034	4 971 190	35	.93	32.55
1902.....	146 295	17 262 810	118	.42	49.56
1903.....	143 369	10 322 568	72	.72	51.84
1904.....	147 670	15 948 360	108	.47	50.76
Average.....	149 126	12 760 206	85.0	.59	44.48
1905.....	149 174	11 186 025	75	.67	50.25
1906.....	150 638	14 611 886	97	.62	60.14
1907.....	154 000	13 398 000	87	.72	62.64
1908.....	156 000	11 076 000	71	.83	58.93
1909.....	164 000	14 924 000	91	.61	55.51
Average.....	154 762	13 039 182	84.2	.69	57.49
1910.....	169 000	12 675 000	75	.59	44.25
1911.....	138 000	6 900 000	50	.90	45.00
1912.....	137 000	13 837 000	101	.60	60.60
1913.....	125 000	5 750 000	46	.89	40.94
1914.....	124 000	7 440 000	60	.61	36.60
Average.....	138 600	9 320 400	66.4	.718	45.47
1915.....	126 000	13 860 000	110	.59	64.90
1916.....	125 000	7 250 000	58	1.79	103.82
1917.....	150 000	13 500 000	90	1.52	136.80
1918.....	160 000	11 520 000	72	1.48	106.56
1919.....	155 000	8 060 000	52	1.96	101.92
Average.....	143 200	10 838 000	76.4	1.468	102.80
1920.....	122 000	7 930 000	65	1.45	94.25
1921.....	121 000	6 413 000	53	1.40	74.20
1922.....	107 000	6 741 000	63	.90	56.70
1923.....	104 000	9 568 000	92	.88	80.96
1924.....	104 000	11 960 000	115	.75	86.25
Average.....	111 600	8 522 400	77.6	1.076	78.47
1925.....	72 000	4 320 000	60	2.35	141.00
1926.....	61 000	4 880 000	80	1.75	140.00
1927.....	64 000	5 376 000	84	1.15	96.60
1928.....	74 000	8 125 000	110	.65	71.50
1929.....	63 000	5 040 000	80	1.55	124.00
Average.....	66 800	5 548 240	82.8	1.49	114.62

¹Based on data procured from Yearbooks of the U. S. Department of Agriculture and from the Illinois Crop and Livestock Statistics issued by the U. S. Department of Agriculture cooperating with the Illinois Department of Agriculture.

tremely hot weather. Late varieties are planted at such times as to permit their more active growth and tuber formation during the cool fall months when rainfall is likely to be plentiful.

The potato plant is sensitive to both drouth and excessive moisture. The greatest hazard in Illinois is drouth (Table 2). Potatoes require a constant supply of moisture. This condition is best fulfilled by well distributed showers. Beating rains not only pack the soil, but cause injury to the vines. An abundant supply of moisture is most important at the time of tuber formation.

Potatoes Require a Rich Soil

The plant-food materials in the soil should be readily available for potatoes. This requirement is due no doubt in part to the rapid growth of the plant and in part to its meager root system.

Since the control of soil moisture is very important in the production of potatoes, the physical condition of the soil should be such as to permit rapid drainage after excessive rains and at the same time retention of sufficient moisture over a period of drouth for maximum growth. A deep sandy loam rich in organic matter with good natural drainage is an ideal potato soil. Peat soils are also well adapted to potatoes when properly fertilized. A loose, friable soil not only permits the spread of roots, but the free development of tubers. Heavy clay soils or poor sandy soils are not suited to potato culture. Where the soil type is poorly adapted, and the climate is unsuited for best potato production, the question of soil fertility becomes more important.

Soil Management for Potatoes

In order to develop and maintain satisfactory soil conditions for potatoes, legumes should be grown, manure and crop residues should be returned to the land, and a suitable crop rotation should be practiced. These recommendations constitute the fundamental basis of soil management for potatoes in Illinois. Other fertilizers which may be used are to be considered, not as substitutes for manure, legumes, and crop residues, but as supplements. The kind and amount of fertilizer required will vary with individual soils.

Sweet clover is one of the best legumes for a rotation which includes potatoes. It decomposes rapidly when turned under and furnishes an abundance of nitrate nitrogen and organic matter. The commonly grown clovers, together with alfalfa, winter vetch, soybeans, and cowpeas, are recommended legumes for a potato rotation. Rye is frequently used as a green-manure crop. Potatoes may follow the green-manure crop in the rotation to good advantage.

Barnyard manure and crop residues should be well rotted if added to the soil immediately before potatoes in the rotation. In most cases it is advisable to supply these fertilizing materials well in advance in order to insure their decomposition before the potatoes are planted. It is believed by most investigators that undecomposed manure encourages the growth of scab on potatoes.

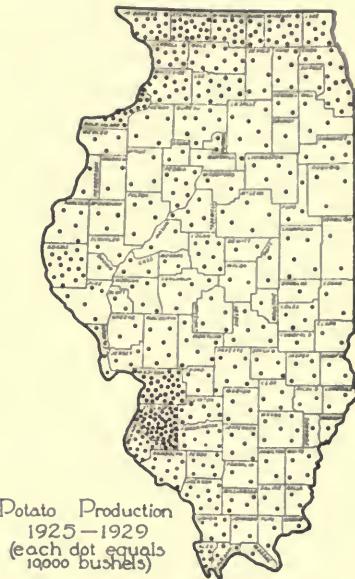


FIG. 1.—AVERAGE ANNUAL POTATO PRODUCTION IN ILLINOIS, 1925-1929

TABLE 2.—ANALYSIS OF YEARLY LOSSES IN POTATO PRODUCTION IN THE UNITED STATES AND ILLINOIS, FOR PERIOD 1914-1923¹
(Expressed in percentage of normal yield)

Year	Area	Total loss*	Total climatic loss	Climatic factors			Biological factors	
				Deficient moisture	Excessive moisture	Other climatic factors	Plant diseases	Insect pests
1914	U. S.	21.20	14.00	5.30	10.20	2.10	1.70	3.30
	Ill.	54.63	50.15	4.34	49.14	(*)	1.91	3.94
1915	U. S.	30.40	14.00	15.50	2.20	8.70	3.10	2.40
	Ill.	14.76	10.18	4.33	.50	8.50	1.10	1.16
1916	U. S.	43.60	31.50	10.30	19.70	6.50	5.30	4.50
	Ill.	52.71	42.37	9.12	33.62	4.45	4.30	4.70
1917	U. S.	23.80	16.30	6.60	8.80	3.50	4.00	2.40
	Ill.	23.59	15.68	6.59	10.36	3.26	2.06	2.69
1918	U. S.	28.30	18.40	8.80	14.70	1.00	2.70	5.30
	Ill.	32.91	20.84	10.00	16.01	1.97	2.86	4.32
1919	U. S.	38.10	23.60	13.80	16.30	5.00	2.30	8.80
	Ill.	51.90	39.80	11.06	31.06	6.84	1.90	5.51
1920	U. S.	21.80	10.20	11.20	6.70	2.20	1.30	8.10
	Ill.	41.96	30.70	10.47	25.04	4.36	1.30	3.41
1921	U. S.	36.20	26.10	9.60	21.70	1.00	3.40	5.70
	Ill.	53.11	36.01	15.55	30.38	1.30	4.33	7.54
1922	U. S.	23.40	14.70	8.50	10.60	2.80	1.30	5.70
	Ill.	43.96	32.02	11.56	28.74	2.18	1.10	4.63
1923	U. S.	22.00	15.40	6.30	11.70	1.60	2.10	3.40
	Ill.	21.20	14.73	6.34	10.88	2.73	1.12	2.82
10-year average.....	U. S.	28.88	18.42	9.59	12.26	3.44	2.72	6.14
	Ill.	39.01	29.25	8.93	23.57	3.56	2.12	3.90

¹From Yearbook for 1924, U. S. Department of Agriculture, with supplementary data from the U. S. Department of Agriculture. ²Includes losses due to other factors as well as to known climatic and biological factors. ³Data not available.

Crop Rotation Essential

Crop rotation gives opportunity to grow legumes and to add fertilizing materials in preparation for the next potato crop. As a precaution against diseases and insects, potatoes should not be grown on the same field oftener than once in three or four years.

Potatoes are well suited to both a short and a long rotation. Wheat, clover, and potatoes make a good combination and one that is adapted to the winter-wheat belt of Illinois. Corn, oats, clover, and potatoes constitute a rotation which may be used in the corn belt. For a longer rotation corn, soybeans, potatoes, and alfalfa are suggested. In this rotation the alfalfa remains on the same field while the other three crops make two complete cycles, after which time the alfalfa is moved to another field. These rotations may be modified by using wheat or rye as the winter grain; oats, barley, or spring wheat as the spring grains; and clover, alfalfa, sweet clover, soybeans or any other adapted legume as the legume in the cropping system.

Seed Bed Preparation

In the culture of potatoes it is recommended that the ground be plowed deep and that the seed bed be kept loose. Plowing should be done preferably in the fall to a depth of 6 to 8 inches. Spring plowing is not to be advised for early planting except where the nature of the soil and the plan of the rotation demand. It can be followed to much greater advantage, however, for late varieties. Where the land is very rolling, it is often advisable to sow rye as a catch crop to be plowed under in the spring.

FERTILIZER EXPERIMENTS

Potato experiments at Urbana were begun in 1904. From the beginning, potatoes were grown in the same rotation and with a definite plan of soil treatment. The rotation included corn, soybeans, potatoes, and alfalfa, the latter remaining on the same field while the other three crops completed two cycles.

In the main the soil type consisted of Black Clay Loam On Drab Clay and Brown Silt Loam On Drift. While the soil was not ideally adapted to potato growing, yet thruout the experiments it continued to be loose, friable, and in good tilth as a result of tile drainage and heavy applications of organic fertilizers.

The soil treatment consisted of 45 tons of well-rotted manure and 1,500 pounds of rock phosphate per acre applied before the land was plowed for potatoes and $1\frac{1}{2}$ tons of limestone per acre distributed over the ground after it was plowed but before the final preparation for corn.

TABLE 3.—YIELDS OF THREE VARIETIES OF POTATOES GROWN ON THE UNIVERSITY SOUTH FARM AT URBANA, WITH SOIL TREATMENTS AS INDICATED, 1912-1921
(Bushels per acre)

Variety and treatment	Number of trials	1912	1913	1914	1915	1916	1917	1918	1919	1920	1921	Average
Early Eureka (Cobbler group)	4	110.1	70.9	25.7	65.2	.....	.....	.....	.....	.....	.....	68.0
All treatments	107.7	65.2	18.3	73.7	.....	.....	.....	.....	.....	.....	66.2
Manure	109.3	78.0	27.2	63.9	.....	.....	.....	.....	.....	.....	70.1
Manure and rock phosphate	113.4	69.5	31.6	56.0	.....	.....	.....	.....	.....	.....	67.6
Manure, limestone, and rock phosphate
Rural New Yorker No. 2 (Rural group)	1	49.5	....	....	....	....	....	....	....	....	....	49.5
All treatments	40.4	....	....	....	....	....	....	....	....	....	40.4
Manure	64.4	....	....	....	....	....	....	....	....	....	55.4
Manure and rock phosphate	53.7	....	....	....	....	....	....	....	....	....	53.7
Manure, limestone, and rock phosphate
Early Ohio (Early Ohio group)	6	....	....	....	....	137.2	98.1	161.7	129.9	93.2	105.5	120.9
All treatments	168.2	105.8	163.1	139.6	96.7	91.4	127.6
Manure	128.7	93.4	161.0	135.6	94.3	120.6	122.3
Manure and rock phosphate	114.7	95.2	161.0	114.5	88.6	103.2	112.9
Manure, limestone, and rock phosphate

NOTE.—The yields shown in the above table, as in all of the data reported in this bulletin, are in terms of *marketable* potatoes.

The check plots of the series continued to be treated with manure alone. The west half of all other plots received rock phosphate in addition to manure, and the east halves of these same plots received rock phosphate and limestone in addition to manure. The arrangement of the plots permits a study of the influence both of limestone and of phosphorus when used with barnyard manure, compared with the influence of manure alone in the production of potatoes.

Since in most cases the check plots were all planted to one variety of potatoes, only the phosphorus and limestone plots which were planted to the same variety could be compared with them. This arrangement limited the comparison to one or two varieties at most each year (Table 3).

Potatoes Tolerant to Acid Soils

In the case of seven of the nine variety groups tested between the years 1910 and 1925 (Table 4), the yield of potatoes was lower on the limed plots than on the plots not receiving limestone. Two groups, Hebron and Rose, show increases for limestone. Cobbler, Rural, and Early Ohio, the three most important groups to Illinois growers, show lower yields where limestone was used. These results would seem to indicate that different varieties respond differently to applications of limestone, but taken as a whole they confirm the general opinion that the potato plant is tolerant to acid soils.

Of nine tests of fertilizer treatments for potatoes conducted on six soil experiment fields over the state, five show decreases for limestone and four give slight increases.^{1*}

AVERAGE YEARLY INCREASES AND DECREASES FOR LIMESTONE ON SIX FIELDS

Field	Basis of comparison ^a	Years tested	Bushels per acre
Union Grove.....	M/ML	1913-1919	-17.1
LaMoille.....	M/ML	1913-1920	- 5.8
Dixon.....	M/ML	1913-1920	- 3.9
Dixon ^b	MK/MKL	1915-1920	- 4.7
Lebanon.....	M/ML	1911-1920	- .8
Mt. Morris.....	M/ML	1913-1920	+ 5.7
Sparta.....	M/ML	1917-1922	+ 6.6
Lebanon ^b	M/ML	1921-1924	+ 4.6
Lebanon ^b	MsP/MsPL	1921-1924	+ 3.3

(The symbols in this column indicate the treatments compared. M/ML, for example, indicates that yields from plots receiving manure are compared with those from plots receiving manure and limestone. K = potassium, sP = superphosphate (acid phosphate), rP = rock phosphate, and 0 = no treatment. ^bA change in fertilizer treatment, a change in rotation, or a variation in plot arrangement makes more than one comparison possible on the Lebanon and Dixon fields.)

Under Illinois conditions it would therefore seem necessary to apply this element only where the soil is too acid to grow a legume in the rotation with potatoes.

*See "Literature Cited," page 283.

TABLE 4.—EFFECT ON YIELD OF POTATOES OF ADDING LIMESTONE TO SOIL URBANA, ILLINOIS, 1910-1925

Group	Number of trials	Lime plots ¹	No-lime plots ¹	Increase or decrease for lime
		bu.	bu.	bu.
Cobbler.....	13	72.38	81.68	-9.30
Triumph.....	1	77.10	78.20	-1.01
Rose.....	12	47.94	41.79	+6.15
Early Ohio.....	18	85.59	88.68	-3.09
Hebron.....	6	71.52	58.65	+12.87
Burbank.....	4	50.83	57.48	-6.85
Green Mountain.....	10	54.00	54.01	-.01
Rural.....	23	85.00	88.82	-3.82
Peachblow.....	3	66.58	81.19	-14.61

¹Both the lime and no-lime plots have received rock phosphate and manure.

Potato Soils Vary in Need for Phosphorus

The results for rock phosphate and manure compared with manure alone in the case of Early Eureka, Rural New Yorker No. 2, and Early Ohio are shown in Table 3. Early Eureka, as an average of four trials, showed an increase of 3.9 bushels an acre a year for rock phosphate. Rural New Yorker No. 2 showed an increase of 14.0 bushels in the one test made with it. But Early Ohio, grown for six years, showed an average decrease of 5.3 bushels an acre a year. Judging from the results of these tests the use of rock phosphate is not justified where heavy applications of barnyard manure are made, since this amount of manure carries far more phosphorus than is needed for the crops in this rotation.

Potatoes have been grown in nine soil experiment field tests in the state where rock phosphate has been used. Six of these tests gave increases in yield, some very slight, and three gave decreases for rock phosphate.^{1, 2*}

AVERAGE YEARLY INCREASES AND DECREASES FOR ROCK PHOSPHATE ON SIX FIELDS

Field	Basis of comparison ^a	Years tested	Bushels per acre
Union Grove.....	ML/MLrP	1913-1919	+ 1.2
Mt. Morris.....	ML/MLrP	1913-1920	+ 1.4
Dixon.....	ML/MLrP	1913-1920	+ 4.1
Lebanon.....	ML/MLrP	1921-1924	+ 5.4
Lebanon ^b	MLrP(residual) /MLrP(residual)rP	1921-1924	+ 7.3
Dixon ^b	MLK/MLKrP	1915-1920	+ 2.3
Sparta.....	ML/MLrP	1917-1922	-13.2
Lebanon ^b	ML/MLrP	1911-1920	- 8.2
LaMoille.....	ML/MLrP	1913-1920	- 8.2

(^{a,b}See footnotes to similar tabulation on page 249.)

In all these tests manure and limestone were used in addition to phosphorus. To a part of the Dixon field, from 1915 to 1920, potassium was applied in addition to the other fertilizer. The Lebanon field, from 1921 to 1924, received rock phosphate alone, but previously

(1911-1920) had received manure, limestone, and rock phosphate.

The low average increase in yields for phosphorus is probably due to the following facts: (1) the soils already contained sufficient phosphorus, as indicated by the low increases in other field crops from its use; (2) additional phosphorus was applied in the manure and crop residues; and (3) good rotations were practiced in which deep-rooting legume crops were frequently grown.

On only one of the soil experiment fields (Lebanon) have both superphosphate and rock phosphate been used. For the period 1925-1928 superphosphate in addition to legumes gave 7.5 bushels more than rock phosphate and legumes. On other plots of the same field superphosphate in addition to straw gave an average increase of 28.4 bushels over straw alone, while rock phosphate in addition to straw gave an increase of 15.8 bushels over straw alone. Sufficient data are not available to draw definite conclusions as to the merits of the various carriers of phosphorus. It is recommended that the soils be tested to determine the need for phosphorus, as outlined in Illinois Bulletin No. 337,^{3*} and that when needed, the carrier be used which promises to give the largest net returns under the conditions at hand.^{3*}

Organic Manure Gives Large Returns

While it is not possible to determine the value of manure for potatoes from the plots at Urbana, yet the six soil experiment fields in the state where manure has been used show yearly increases ranging from 6.5 to 89.0 bushels an acre and averaging 32.8 bushels. The results are as follows:^{1*}

AVERAGE YEARLY INCREASES FOR ORGANIC MANURE ON SIX FIELDS

Field	Basis of comparison ^a	Years tested	Bushels per acre
Lebanon.....	0/M	1911-1920	+12.4
Lebanon ^b	0/M(residual)	1921-1924	+ 6.5
Dixon.....	0/M	1913-1920	+38.8
Dixon ^b	K/KM	1915-1920	+50.4
LaMoille.....	0/M	1913-1920	+32.6
Mt. Morris.....	0/M	1913-1920	+48.0
Sparta.....	0/M	1917-1922	+ 8.9
Union Grove.....	0/M	1913-1919	+89.0
Lebanon ^b	sP/M(residual)sP	1921-1924	+ 8.9

(^{a,b}See footnotes to similar tabulation, page 249.)

Thus barnyard manure has given the most consistent and the largest increases of any fertilizer used.

Straw used as a mulch on the Lebanon field, as an average of four years (1925-1928), produced 41.6 bushels more than the manure plot. Greater increases from phosphorus, as indicated above, were obtained where straw was used as a mulch.

For most soils in the state the use of organic manure, it seems clear, will materially increase the yield of potatoes.

Potash Needed for Certain Soils

Potash has not been used on the Urbana plots for potatoes. It has been tried, however, in seven tests on three soil experiment fields in the state. In three of these tests decreases are to be noted, while in the four tests at Dixon increases were obtained.^{1, 2*}

AVERAGE YEARLY INCREASES AND DECREASES FOR POTASH ON THREE FIELDS

Field	Basis of comparison ^a	Years tested	Bushels per acre
Sparta.....	MLrP/MLrPK	1917-1922	-11.4
Lebanon.....	SP/sPK	1925-1928	- 9.0
Lebanon ^b	rP/rPK	1925-1928	- .6
Dixon.....	0/K	1915-1920	+ 6.0
Dixon ^b	M/MK	1915-1920	+12.8
Dixon ^b	ML/MLK	1915-1920	+11.4
Dixon ^b	MLrP/MLrPK	1915-1920	+13.7

(^{a,b}See footnotes to similar tabulation, page 249.)

Most of the soils of the state have been found to contain sufficient potassium for crops other than potatoes. Only sandy, peaty, and clay soils low in active organic matter are likely to be deficient in this element. The use of potash in potato growing is recommended only for those soils that are known to have an insufficient amount of potassium in available form.

Commercial Fertilizers

Under certain conditions commercial fertilizers that contain either two or three of the plant-food elements nitrogen, phosphorus, and potassium may prove desirable for the growing of potatoes. The use of commercial fertilizers, however, is to be considered only where it is clear that profitable increases in yield cannot be obtained in more economical ways.

It is a common practice, even on the more fertile soils, to use commercial fertilizer when it is desired to give the potato crop a quick start in early spring. Under these conditions the fertilizer is hill-dropped at planting time. Judging from the experience of growers, this practice may prove profitable at times.

One usually builds up the fertility of the soil before attempting to grow potatoes. In order to hasten the time when potatoes can be grown, the use of commercial fertilizers may be justified under certain conditions.

The tenant farmer who wishes to improve his potato crop but does not have the cooperation of his landlord in practicing a permanent system of soil fertility can sometimes use commercial fertilizers to advantage.

Because the potato plant is a delicate feeder, many growers use commercial fertilizers to supplement their more permanent system of soil improvement.

The proportion in which it is desirable to use the three plant-food elements making up the commercial fertilizer will vary according to the needs of the soil. For dark-colored silt or clay loam soils of Illinois it may be worth while to try a commercial fertilizer such as 3-18-9; for light-colored soils, a 3-15-12 mixture; and for sandy soils a 3-9-18 fertilizer. Where such mixtures are used, they should be drilled at the rate of 500 pounds to the acre or broadcasted at the rate of 1,000 pounds to the acre.

VARIETY TRIALS OF POTATOES

Variety trials of potatoes were begun on the University field at Urbana in 1904 on the same plots and with the same soil conditions described under the fertilizer experiments except that all plots were fertilized alike. The varieties extended across the lime and no-lime plots, both of which included manure and phosphorus, so that the yields recorded are the average of the lime and no-lime treatments. The rotation is the same as for the fertilizer experiments described above. The yields of the different varieties grown in these tests are shown in Table 5. The "percentage rating," based on yields of Early Ohio during the same years, affords a means of making direct comparisons among all the varieties.

Varieties of the Cobbler and Early Ohio groups are the most consistent high-yielding early potatoes. These two groups are nearly equal in performance. Varieties represented by the Triumph group are very early but yield low because they are unsuited to Illinois conditions. Two varieties (Early Roser and Pat's Choice) representing the Rose group and one variety (Bovee) representing the Hebron group have high percentage ratings, but the two groups as a whole are low-yielding.

Of the medium-late and late varieties the Rural group is far superior to the others, as shown by the percentage ratings. Carmen No. 3 is an outstanding late variety with a rating of 154.35. Other good late varieties of the Rural group are Banner (149.01) and Sir Walter Raleigh (107.83). Gold Coin, a medium-late variety of the Green Mountain group tried out only two years, and Livingston, a late variety of the Peachblow group tested but one year, would appear to be promising, having rated 127.63 and 148.66 percent respectively, but these two have not been grown long enough to afford a reliable basis for recommendation.

Pink Gem, a variety that has not been classified definitely, yielded 91.97 bushels as an eight-year average, while Early Ohio yielded 60.93 bushels during the same period.

Among the high-yielding early potatoes Irish Cobbler and Early Ohio are suggested because of their consistent high yields and be-

TABLE 5.—VARIETY YIELDS OF POTATOES GROWN AT URBANA, 1904-1925

Group	Seasonal classification	Sectional and varieties represented	Number of trials	Period tested	Average yield	Average yield of Early Ohio for same years	Percentage rating based on Early Ohio
Cobbler.....	Early.....	Eureka..... Irish Cobbler.....	11 7	1904-15 (except 1906)..... 1915-21.....	bu. 64.40 97.96	bu. 64.86 96.31	99.28 101.71
	Very early.....	Bliss' Triumph..... Triumph.....	1 3	1919..... 1904, '05, '07.....	77.60 25.42	88.25 47.98	87.93 52.98
Rose.....	Early.....	(Section 1)..... Early Rose..... Early Roseer..... (Section 2)..... Manistee.....	2 7 7 4	1910, 1911..... 1905-11..... 1905-07, 1912..... 1919-20.....	45.23 74.94 34.93 29.18	64.05 62.91 53.10 73.45	70.61 119.12
	.....	King..... (Section 3)..... Pat's Choice..... White Seneca.....	2 7 3 3	1904, '05, 1907-11..... 1916-18..... 1904-25..... 1904-11.....	62.44 62.03 81.83 60.86	61.21 110.07 99.88 60.03	102.00 56.35
Early Ohio.....	Early.....	Early Ohio..... Aeme.....	22 8	1904-10..... 1908-11.....	70.22 53.22	60.78 71.14	115.63 74.81
	.....	Bovee..... White Victor..... Beauty of Hebron.....	7 4 3	1916-18.....	76.07	110.07	69.11

TABLE 5.—(Concluded)

Group ¹	Seasonal classification	Sectional and varieties represented ²	Number of trials	Period tested	Average yield	Average yield of Early Ohio for same years	Percentage rating based on Party Ohio
							bu.
Burbank.....	Medium-late...	(Section 1).	3	1910-12.....	59.93	61.55	97.36
		Burbank.		1919.....	36.45	88.25	41.33
		(Section 2).	1	.....	.....	.....	.....
Green Mountain.....	Medium-late...	(Section 1).	2	1918, 1919.....	27.80	111.68	24.89
		Green Mountain.	6	1913-18.....	53.49	93.11	57.44
		Delaware.	2	1910, 1911.....	81.75	64.05	127.63
		Gold Coin.	2	.....	.....	.....	.....
		(Section 2).	1	1904.....	8.25	47.04	17.53
		White Mountain.	1	.....	.....	.....	.....
	
Rural.....	Late.....	(Section 1).	8	1904-11.	94.05	60.93	154.35
		Carmen No. 3.	19	1912-20, 1922-24.....	71.48	85.99	83.12
		Rural New Yorker No. 2.	12	1904-12, 1915-17.....	81.11	75.22	107.83
		Sir Walter Raleigh.	7	1904-07, 1909-11.....	90.93	61.02	149.01
		Banner.	1	1911.	92.11	61.96	148.66
Peachblow.....	Late.....	Livingston.	2	1910, 1915.....	61.78	114.84	58.40
		Seneca Beauty. . . . .	.....	.....	.....	.....	.....

¹Stuart's classification with respect to groups and sections has been followed with few exceptions, ²A variety known as Pink Gem has not been classified definitely. Over a period of eight years it yielded 91.97 bushels, while Early Ohio (the variety used as the basis for comparison) yielded 60.93 bushels.

cause certified seed of these varieties is readily obtainable. Furthermore these are the varieties that have been most widely accepted by Illinois growers.

Carman No. 3 is recommended as a late variety.

SELECTING SEED POTATOES

Certified Seed Preferable

In regions of favorable climate some growers specialize in producing potatoes for seed purposes. Where seed stock has been grown under the supervision of inspectors, it is known as "certified seed." The growing crop is inspected in the field for variety mixtures and diseases. After harvest, the tubers are inspected for tuber-borne diseases, variety type, and for conformation to the general seed requirements of the seed-certifying organization. In some cases laboratory inspection for the so-called "degenerate diseases" is carried on in greenhouses in the winter. The yield per acre must be high in order to entitle the crop to be certified for seed.

Certified stock is so labeled after a certificate of inspection has been granted, and it is sold on the market at a premium for seed purposes. If certified seed potatoes are available, it is recommended that they be used in preference to common stock, and that they be secured each year from those sections where the climate is best adapted to this crop, as in the northern potato regions of the United States.

Selecting Seed From Non-Certified Stock

When certified seed is not available, and the producer must select seed from non-certified stock, he should keep the following points in mind:

1. Seed potatoes should be true to type. Irregularly shaped, knotty tubers should be avoided.
2. Only strong, vigorous seed stock should be planted. Tubers tending to be long, slender, and pointed at the ends are characteristic of potatoes that are running out.
3. Seed potatoes should have been held under good storage conditions. Seed of low vitality results from poor storage.
4. Northern-grown seed stocks should be secured yearly. Potatoes grown in a warm climate, as in southern Illinois, degenerate to such an extent in one season that they usually are not fit for seed.
5. Seed potatoes should be selected from strong, healthy plants. Potatoes from plants that have been injured by insects or diseases do not make good seed.
6. Seed from abnormal plants should be avoided. An abnormal plant may be the result of improper environmental conditions or it may be the result of degeneracy.

Source-of-Seed Experiments

A study of home-grown and northern-grown seed potatoes was begun by the Illinois Station in 1905. Each year new importations of northern-grown seed, principally from Wisconsin, were made for this experiment. Only those potatoes that had been removed one year from the north were used as home-grown seed. These tests were conducted on the same plots and under the same conditions of soil management as the experiments previously reported in this bulletin. Northern-grown and home-grown tubers were planted in adjacent plots one-fifth acre in size and were replicated from two to four times in various years.

The results of the above tests, summarized in Table 6, emphasize the importance of securing northern-grown seed in general and especi-

TABLE 6.—COMPARATIVE YIELDS OF NORTHERN-GROWN AND HOME-GROWN SEED POTATOES AT URBANA, 1905-1913 AND 1918-1920
(Bushels per acre)

Group	Number of trials	Northern-grown	Home-grown	Difference in favor of northern seed ¹
Cobbler.....	7	79.31	52.78	+26.53
Triumph.....	1	29.80	31.00	-1.20
Rose.....	7	64.57	56.03	+8.54
Early Ohio.....	15	62.39	61.12	+1.27
Hebron.....	3	64.25	46.99	+17.26
Rural.....	17	77.69	74.66	+3.03

¹Figures showing a minus sign (—) are in favor of home-grown seed potatoes.

ally for certain varietal groups. As an average of fifty trials for all varieties, covering a period of twelve years, northern-grown seed yielded 11.8 percent more than home-grown seed. In the case of the Cobbler group, the northern seed yielded 50.2 percent more than the home-grown tubers. These differences would be more marked, according to experiments reported from other stations, if the same home-grown strain had been used over a period of years instead of one year.

In experiments by the Nebraska Station home-grown potatoes produced under a mulch proved equivalent, under eastern Nebraska conditions, to northern-grown seed potatoes.^{6*}

PLANTING AND CULTIVATING

Cutting Seed Potatoes

A two-ounce seed piece is about the proper size, all factors considered. While many experiments have shown that larger seed pieces give higher total yields than smaller seed pieces, the planting of exceedingly large pieces is not justified because of the very large amount

of seed that is necessary and the low percentage of marketable tubers in the crop produced.

In cutting the tuber, it must be kept in mind that a blocky seed piece is to be preferred to a long thin one (Fig. 2). The blocky piece not only handles better while being planted, but at the same time loses less moisture and consequently shrivels less.

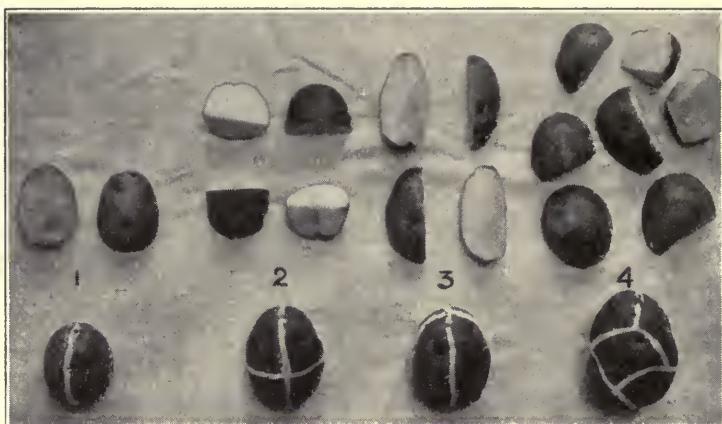


FIG. 2.—A BLOCKY SEED PIECE WEIGHING ABOUT TWO OUNCES IS BEST

Groups 1, 2, and 4 suggest the best methods of cutting various sizes of potatoes. Avoid long, thin pieces such as are shown in No. 3. The size of the seed piece should be governed by the fertility of the soil, the available moisture, and the rate of planting. Large sets, including whole tubers, usually produce a larger number of stems, and unless there is sufficient moisture and plant food available, the resulting crop will include a high percentage of unmarketable potatoes.

When potatoes must be cut a long time before planting, some effort should be made to dry the cut surfaces. If cut tubers are heaped in large piles before they have become dry, heating is likely to occur. Such a condition materially lowers the germination of the seed pieces and thus renders them unfit for seed. It is a common practice to dust land-plaster, air-slaked lime, or flowers of sulfur on the cut surfaces. Some growers store the cut seed in slatted bushel boxes in such a way as to provide ample ventilation. In no case should cut tubers be piled in bulk until they have been properly cured.

Another method of handling the freshly cut pieces is to spread them out on a dry floor in thin layers. These should be turned frequently until dry. The interval between cutting and planting should be as short as possible.

Early Planting Best

The best time for planting potatoes varies with the locality and also with the earliness or lateness of the variety. For Illinois, early varieties should be planted as soon as the ground can be worked in the spring, so that the crop will mature before the hot weather of July and August. In southern Illinois early varieties are grown mostly, and these are usually planted the latter part of March or the first part of April, depending upon weather conditions. May 15 to June 1 is satisfactory for planting late potatoes.

Depth, Rate, and Distance of Planting

In general, potatoes should be planted 3 to 5 inches deep. Where the soil is warm, light, and well drained, deep planting provides more favorable moisture and temperature conditions.

The average rate of planting varies from 10 to 20 bushels to the acre. The size of the seed piece and the distance of planting determine the quantity required. By increasing the rate of planting, the yield is increased, but the yield per hill and the size of the tubers are reduced. The rows should be 28 to 36 inches apart, with the hills 10 to 24 inches apart in the row. On rich soils the potato sets can be placed as close as 10 or 12 inches.

Cultivation Highly Important

Cultivation is one of the important factors in the production of potatoes, and the time of cultivation is as important as the number of cultivations. The soil should be stirred as soon as possible after each heavy rain in order to prevent a crust from forming. As an average, potatoes should be cultivated once every week or ten days during the early growing period.

Whether to use ridging or level cultivations is not a matter of choice, but depends upon soil and weather conditions. If the climate is cool and moist or the soil is heavy, wet, and plastic rather than loose and friable, it is better to practice ridge cultivation. For other soils level cultivation is followed. It is a good plan to ridge after the tubers begin to form, in order to prevent exposure to the sun, as this may cause a second growth. Level cultivation is practiced in warm, dry climates in order to conserve moisture and to lower the soil temperature.

The first cultivation of early potatoes should be deep and close to the hills in order to loosen the soil which has been packed by beating rains and by planting operations. Tillage should be shallow after the roots form. Root pruning at the critical period, which comes at blooming time when the tubers are forming, is especially injurious.

Mulching Potatoes on Small Areas

The growing of potatoes under a mulch is well adapted for small areas, especially for home consumption. In years of deficient moisture the yields of mulched potatoes are higher than those of cultivated tubers. One of the handicaps to growing potatoes in Illinois in normal years is insufficient moisture. This may account in part at least for the markedly increased yields obtained on the Lebanon field as a result of mulching (page 251).

The quality of the crop is also much improved by mulching. When mulched potatoes are cooked, they are mealy and of good flavor; and when used for seed, they are about equal to northern-grown tubers.

The mulching of potatoes is limited to small areas because of lack of mulching material. The fields are usually not more than an acre in size and often less. Such materials as grain straw, corn stover, strawy manure, and low grade grass and legume hays are used.

A field selected for mulched potatoes should have good drainage. The tubers are planted the same as for cultivated potatoes, tho some growers prefer to plant them shallow and as much as a month later. As soon as the seed pieces have germinated, the ridges are leveled so as to bring the seed pieces near the surface of the soil. The mulch is then applied to a depth of four to six inches, depending on the consistency of the material; heavy wet material should be applied thinner. Mulching material free from weed seeds and small grains will give least trouble from weed growth. In some cases the straw is retained and used a second year. Mulched potatoes need no cultivation but should be sprayed or dusted to control insects and disease.

The mulch conserves moisture, lowers the soil temperature, and probably modifies the biological action of the soil.

HARVESTING AND STORING

Because of the prevailing high prices of potatoes early in the season, harvesting of early varieties usually begins before the crop is mature. The attractiveness of the price determines very largely the time of digging. If the price is high, harvesting should begin earlier and continue more rapidly than if the price is low. As a rule, the loss in yield by early harvesting is compensated by the higher price. Immature tubers are perishable and are marketed direct from the field. Potatoes to be stored for home use are harvested when mature.

Late Potatoes for Storage

In general, only late potatoes are stored for market. The tubers should be dug when the soil is dry in order that they may go into storage as free from dirt as possible. In some cases it is advisable

to leave the ripe tubers in the ground until the cool weather of fall, provided the soil is dry. Wet ground may cause second growth of tubers, or even sprouts from the buds. It is desirable to allow the tubers to dry in the field or in a well-protected shed for a week or ten days before putting them into storage, in order to reduce the water content and to complete the ripening process. Under proper conditions



FIG. 3.—HIGHEST PRICES ARE PAID FOR THE
BEST PRODUCT

Illinois has adopted the U. S. standard grades for potatoes and these should be followed in marketing the crop. The above lot would be classed as U. S. Grade No. 1.

potatoes for storage should be harvested just before frost. They should be well sorted and any diseased or damaged tubers discarded (Figs. 3 and 4).

Avoid Bulk Storage

Potatoes should not be stored in bulk when other methods can be employed. If they must be stored in bulk, they should not be piled more than three or four feet high. They should be placed on a platform several inches above the floor and kept away from the walls

so that good ventilation is possible. Storing in sacks has about the same effect as in bulk. The use of crates for storage gives excellent results.

Temperature and Humidity

The temperature of a storage room for potatoes should be about 40° to 45° F. at the beginning of the storage period, and then gradually lowered to 34° to 36° F. as the season progresses. Owing mainly



FIG. 4.—UNGRADED AND UNMARKETABLE POTATOES

Frosted, knotty, dirty, small or injured tubers mixed with good potatoes give the entire lot a poor appearance. By following improved cultural practices, the percentage of culls may be cut down to a minimum.

to poor ventilation, the temperature of most farm cellars early in the fall ranges from 50° to 60° F. When stored at too low temperatures, potatoes acquire a sweet taste as a result of an accumulation of sugar. This condition is not desirable for food potatoes.

The humidity of a storage room that has a temperature of 34° to 36° F. should be between 85 and 90 percent. A storage room that is supplied with artificial heat is often too dry, while one that is

built in a low, wet place is too damp. Humidity is as easily controlled as temperature. It may be reduced by scattering calcium chlorid or lime over the floor, and may be increased by sprinkling water on the floor or placing it in vessels about the room.

Ventilation and Light

Since the products of respiration and decay tend to accumulate in storage rooms, it is necessary that the cellar be well ventilated.



FIG. 5.—FIRST-CLASS SEED POTATOES CAN BE RUINED
BY POOR STORAGE

These tubers were stored in a warm, moist basement. If used for planting, the next shoots arising from the buds will lack vigor, and weak plants and poor stands will result.

Provision should be made for some ventilation even during the coldest weather, while on warm days windows and doors may be opened.

Light also is a factor in the storage of potatoes. It is generally recognized that table stock should be stored in the dark because "greening" by light develops the acrid taste which is characteristic of exposed potatoes. When the tubers are stored in containers that give this protection, the admittance of the sun's rays into the storage room is not objectionable, since it aids in the control of disease and tends to remove excessive moisture from the walls; but if the tubers

are not so stored as to be otherwise protected from the light, the storage room should be kept dark. For seed potatoes, however, the cellar in the spring should have light without warmth.

Proper Storage Essential for Good Seed

Successful production of potatoes depends, among other things, upon using seed that has been properly stored. Alternate extremes of any one of the above factors—temperature, humidity, ventilation, and light—are detrimental. Potatoes grown under the best possible conditions make very poor seed stock if the tubers are allowed to sprout and wilt until they are materially reduced in weight (Fig. 5). In tests by the Nebraska Experiment Station properly stored tubers gave 56 percent greater yields than poorly stored tubers taken from the same lot.^{6*}

MACHINERY FOR POTATO PRODUCTION

Special machinery is necessary for success in the culture of potatoes on a large scale, and for that reason potatoes may be considered a special crop. For small areas the machinery used in the production of other crops can be adapted in part.

Most seed potatoes are cut by hand, even for large plantings, since cutting machines are not entirely successful. For the grower of a few acres, hand cutting is to be recommended.

Where labor is scarce and a large acreage of potatoes is desired, horse-drawn planters are used. These are of two kinds—the picker type and the revolving disk type. In the picker type the seed pieces are picked up by a revolving fork and dropped at intervals. With uniform seed pieces, this machine plants satisfactorily and can be operated by one man. The other horse-drawn planter is equipped with a revolving disk which receives pieces that have been raised from the hopper and deposits them in the dropping tube (Fig. 6). While this machine requires an extra man to see that each compartment of the disk contains one seed piece, yet the accuracy of planting approaches perfection.

For a few acres potatoes are hand-dropped in an open furrow and covered with a corn cultivator. Light harrows or weeders and almost any type of cultivator can be used in the tillage of the crop.

Except in commercial potato regions, potatoes usually are dug by hand with a hoe or fork. A turning plow can be used to good advantage. In the commercial potato regions potato diggers are to be found.

There is no substitute for good spraying machinery. In order to properly apply insecticides and fungicides in either the dust or the liquid form, it is necessary to have sprayers or dusters of ample

capacity for the area to be covered. For less than a half-acre a knapsack sprayer with a short extension rod having a curved nozzle attachment at the end for spraying the undersides of the leaves will be found satisfactory, or a blower type of hand duster may be used. For fields of a half-acre to two acres a barrel pump mounted



FIG. 6.—PLANTING POTATOES BY MACHINE

With this type of potato planter the man on the rear seat feeds the machine and makes possible a perfect stand. On rich land the potato sets are placed 15 to 20 inches apart in the row, with the rows as close together as cultivation will permit.

in a wagon with a special boom attachment will do very satisfactory work, or a large hand duster may be used. For more than two acres either traction or a power-driven sprayer or duster should be available. If one is inadequately equipped for applying either sprays or dusts, the operation is likely to be poorly done, with correspondingly poor results.

POTATO DISEASES AND THEIR TREATMENT

One of the greatest hazards to potato production in Illinois is potato diseases (Table 2). It has been estimated they cause an average annual loss in this state of over \$375,000. This large waste may be reduced by the exercise of care on the part of the potato grower.

Potato diseases may be roughly grouped into three divisions: (1) those due to organisms that live from year to year in the soil; (2) those from organisms that live over winter on the potato tuber in storage; and (3) those that are caused by air-borne spores.

Diseases caused by soil-borne organisms are beyond the direct control of the farmer. Most of these organisms are capable of living in the soil several years without a potato crop. Infected fields should not be planted to potatoes for five or six years if it is practical to avoid doing so. Beets, turnips, mangels, and rutabagas, which are susceptible to many of the same soil-borne disease organisms as potatoes, should be omitted from the rotation.

Disease organisms carried on the seed are responsible for certain potato diseases. Potatoes for planting should always be carefully selected for their soundness and freedom from disease, as explained on page 256.

Even after careful selection, it is advisable to disinfect seed tubers. If diseases are known to have been present in the lot from which the seed was selected, this treatment is urgently recommended. Formalin, mercuric chlorid (corrosive sublimate), and organic mercury compounds are used. Formalin is effective for all common tuber diseases except Rhizoctonia, and is not poisonous to man or animals as used on potatoes. The cold formalin treatment is used in the proportion of 1 pint (1 pound) of formalin to 30 gallons of water. Potatoes are placed in this solution, either in sacks or loose, before they are cut, and they are allowed to remain in it for about two hours. For the hot formalin treatment use 1 pint of formalin to 15 gallons of water. The solution must be maintained accurately at 124° to 126° F. The tubers are allowed to remain in the solution only 3 or 4 minutes. This method is adapted where equipment is available for maintaining accurate temperatures and where large quantities of potatoes are to be treated.

Mercuric chlorid (corrosive sublimate) is effective for all tuber diseases that can be prevented by seed treatment. *It should be used with great care, however, because it is a violent poison and all potatoes treated with it and not used for seed should be buried or burned.* It is employed in the same manner as formalin, 4 ounces of corrosive sublimate being used to 30 gallons of water. A wooden barrel or earthen jar should be used, as this solution corrodes metals. The potatoes should be soaked for an hour and a half before being cut. Because of the gradual loss of strength, a corrosive sublimate solution should be replaced by a fresh solution after four batches of potatoes have been treated.

The use of organic mercury compounds for the treatment of seed potatoes is new. These compounds are just being tried out by experiment stations for the treatment of seed-borne diseases, and whether this treatment is superior to the older treatments already described remains to be determined. The general recommendations are to use about 1 pound of the compound to 2½ gallons of water.

This amount of solution will treat 12 to 15 bushels of potatoes. The tubers are dipped into the solution either before or after being cut and are removed at once and allowed to dry. In all cases the specific directions of the manufacturer should be followed.

As organic mercury compounds are very poisonous, tubers treated with them should be handled with the same precautions as tubers treated with mercuric chlorid.

Diseases caused by air-borne organisms. Diseases of the foliage may be effectively controlled by spraying with bordeaux mixture or dusting with a standard copper dust. Spraying and dusting are preventives and their application should therefore be made before the disease has gained a foothold. In sections where blights have caused destruction, spraying should be begun when the plants are 6 to 8 inches high, and repeated four times at intervals of ten days to two weeks. On an average, about 50 gallons of spray to the acre is required for the first application. The amounts of spray are increased for each succeeding application, depending upon the size of the plants. One hundred or more gallons to the acre is required for full-sized plants. By making frequent applications, the newly formed leaves are coated with the solution, and this prevents the development of blight.

Late Blight

(Caused by *Phytophthora infestans*)

While late blight is the most serious potato disease in the United States, yet in Illinois its slight damage is confined to the northern half of the state. This disease rarely attacks plants before they are 8 or 10 inches high. The first symptom is a browning, or blackening of the tips or margins of the lower leaves. If the weather is dry and cool, development of the disease is slow and the leaves gradually shrivel and curl. Under warm and moist conditions, infection spreads over the entire leaf in one to four days and is accompanied by an offensive odor. On the undersides of the leaves a downy growth often appears. On the tubers the disease appears as spots of irregular size and shape but usually not more than one-eighth of an inch in depth. If the soil is wet at digging time, a secondary infection by soil fungi and bacteria follows blight, causing a wet rot of the tubers.

Control. Spraying with bordeaux mixture at intervals of about ten days beginning when the plants are 6 to 8 inches high is very effective in the prevention of late blight. If the tops have been killed, the potatoes should not be dug until ten days or two weeks later, in order to prevent infection of the tubers thru contact with the diseased tops, and to allow infected potatoes to decay, thus preventing their storage with the sound crop.

Early Blight

(Caused by *Alternaria solani*)

Early blight, contrary to its name, makes its appearance rather late in the season. It usually attacks the crop about the time the plants are setting tubers. The leaves are the only part of the potato plant attacked. The spots are dark brown or black and usually show



FIG. 7.—POTATOES AFFECTED WITH SCAB

Scab is one of the most widespread of potato diseases and also one of the most destructive. It can be controlled by treating the seed potatoes with formalin or corrosive sublimate.

a series of ridges. Enlargement of these spots results in the death of the foliage. The lower leaves are the first to become affected.

Control. Spraying with bordeaux and destroying infected tops before putting in the succeeding crop will effectively control this disease.

Common Scab

(Caused by *Actinomyces chromogenus*)

Common scab is the most universally distributed disease of the potato. Its injury is confined to the tubers, which are rendered unsightly and less marketable by its ravages.

The disease is easily recognized by rough, brownish, corky areas on the surface of the tuber (Fig. 7). Diseased parts contain immense numbers of organisms, and for this reason infected seed serves as the principal means of distribution. A soil in which an infected crop has been produced is a source of trouble for several years.

Control. Prevalence of this disease may be reduced to a large degree by following a system of crop rotation with five or six years

between potato or other root crops, by selection of sound tubers for planting purposes, and by treating all seed tubers with formalin or corrosive sublimate before planting.

Rhizoctonia or Black Scurf

(Caused by *Corticium vagum var. solani*)

In Illinois Rhizoctonia, or black scurf as it is popularly called, sometimes causes serious damage in the northern and central parts



FIG. 8.—BLACK SCURF, OR RHIZOCTONIA, OF POTATOES

The dirty black spots on the surface of these potatoes will not wash off. This disease is more common in northern Illinois than in other parts of the state. It may be controlled by treating the uncut tubers with corrosive sublimate.

of the state. It evidences its presence in a variety of ways. It may cause a poor stand; brownish lesions on the below-ground stems; large tops with few and small potatoes; yellow and folded leaves; entire death of tops during a dry period; dirty, felty appearing growth on the green stems; small aerial tubers springing from the axils of the branches; a cluster of small potatoes near the surface of the ground; or a rosette development of the tops. Any one of the above symptoms, if accompanied with brownish lesions on the stems, is reasonably good evidence that Rhizoctonia is present. The disease may appear on the tubers as black, superficial spots which often are mistaken for dirt (Fig. 8).

Control. As Rhizoctonia is caused by a soil-borne organism, a field producing an infected crop should not again be planted to potatoes for several years. All cracked and suspicious looking tubers should be avoided for seed purposes. If the disease is suspected, the seed potatoes should be treated with corrosive sublimate, which has been found to be superior to the formalin solution.

Blackleg(Caused by *Bacillus atrosepticus*)

Blackleg is a bacterial disease attacking both the stems and tubers of potatoes. It is somewhat common in Illinois and is indicated by an unthrifty, undersized condition of the plant which, instead of spreading normally, tends to grow upright, forming a compact head. The leaves turn to a light green color; later they become yellow and die. If the progress of the disease is rapid, the plants wilt and fall over without any previous symptom except general unthriftness. In all cases blackleg is characterized by marked blackening and shrivelling of the stem from the seed piece up to 2 or 3 inches above the ground. The disease usually appears on isolated plants scattered over a field.

Control. Experiments have shown that this disease does not live over in the soil, but is carried on the tubers. Disinfection with corrosive sublimate (mercuric chlorid) will kill the disease organisms.

Recent evidence indicates that the disease is also carried by the seed corn maggot. The insect lays its contaminated eggs on the freshly cut seed pieces. Later when these eggs hatch, the small larvae burrow into the seed piece carrying the disease germs with it. To effectively control blackleg, the potatoes must be planted as soon as possible after disinfection or stored where the adult maggots cannot reach them.^{8*}

Fusarium Wilt(Caused by *Fusarium oxysporum*)

Fusarium is a widespread soil disease. In the field it attacks the plants when they are about one foot high. It stops the growth and causes the leaves to take on a dull green color. Usually the first part of the plant to show the disease is the lower leaves, which become yellow and roll upward at the margins. The infection spreads gradually and during the heat of the day the leaves wilt. Later stages show the leaves dropping prematurely with the main stem standing erect. A field killed by Fusarium wilt appears to have ripened normally.

Internal infection in the tubers may be recognized by the appearance of brown or blackened areas distributed thruout the flesh of the potato. In storage, the infected tubers develop a dry rot.

Control. The principal means by which Fusarium wilt is distributed is the use of internally infected tubers for seed. The first and most important control measure therefore lies in the careful selection of seed at the time of cutting. A rotation of crops, with five or six years between potato crops, should be practiced on all infected fields. No form of spraying is effective against this disease.

POTATO INSECTS AND THEIR CONTROL

In Illinois the potato is attacked by some eight or ten insects, anyone of which may greatly reduce the yield. The insects here discussed are considered important enough in this state to deserve some mention (Table 2). They do not all occur every year, but one or several of them are sure to be present in every potato field, and in most seasons all of them are reported as causing damage at some point in Illinois.

Colorado Potato Beetle

(Leptinotarsa decemlineata)

The best known, altho usually not the most destructive insect pest of potatoes in Illinois, is the common Colorado potato beetle. Anyone who has ever grown potatoes is familiar with this insect. The adult beetles go thru the winter hidden away in rubbish or buried to a depth of several inches in the soil. They fly abroad in the spring seeking food. The beetles begin feeding on the young potato plants as soon as they come thru the ground, and the females start depositing their eggs in masses of two or three to twenty or more on the leaves and stems of the plant or sometimes on the ground close to the plant. The eggs hatch in about two weeks, and from them emerge small slugs. These slugs feed on the leaves of the plant, and when many of them are present they will completely defoliate it. Upon completing their growth, which is usually accomplished in about three weeks, the full-grown slugs go into the ground and change to a resting stage, and later to adult beetles. Coming out about the middle of the summer, they deposit their eggs for the second generation on late potatoes, tomatoes, eggplants, and some of the weeds closely related to the potato. The second generation matures in about the same length of time as the first, the grubs going into the ground about the middle of August and emerging during the latter part of August or during September as full-grown beetles that hibernate 4 to 10 inches deep in the soil over the winter.

Control. This insect is a leaf feeder, and can be controlled by spraying the foliage with any quick-acting stomach poison. The best spray is arsenate of lead at the rate of 2 or 3 pounds in 50 gallons of water. If spraying is thoroly done, the smaller amount of lead is sufficient. Paris green at the rate of 1 pound to 50 gallons of water, or calcium arsenate, 2 pounds in 50 gallons of water, is also effective. Any of these poisons may be mixed with bordeaux mixture or used in dusts.

The first spray should be applied as soon as the eggs have started hatching. In Illinois it is very seldom that the adult beetles are abundant enough to warrant a spray for controlling them. It is usually

necessary to give a second spray about one week or ten days after the first, as the vines are growing very rapidly at this time and the young that have hatched late will not be poisoned by the first application of the spray.

Potato Leafhopper

(*Empoasca fabae*)

Investigations carried on during the last eight years, particularly in Iowa,^{7*} Wisconsin,^{4, 5*} Ohio, New York, and Illinois have shown that the potato leafhopper is without doubt the most destructive insect



FIG. 9.—POTATO LEAFHOPPER DAMAGE

These leaves are from the same plant, but the one on the left was exposed to potato leafhoppers, while that on the right was protected.

pest of potatoes that we have in the United States. This insect feeds by sucking the sap from the leaves. The amount of sap which is withdrawn is certainly not large, but the effect on the leaf is serious. A substance toxic to the plant tissue is apparently exuded by the insect while it is feeding, and this causes a browning and curling of the leaf tips. Formerly this injury, known as tipburn, was attributed to dry weather, high temperature, or other causes. It has been demonstrated, however, that the injury is due to the feeding of the leafhoppers. Leaves and branches of the same plant exposed to leafhoppers and others entirely protected from them have shown severe tip burning on the exposed branches and none on the protected branches (Fig. 9). This insect is always present in Illinois potato fields and usually in large numbers. It is practically impossible any year to find an unsprayed potato field which does not show injury from this insect.

Adult leafhoppers are active little creatures about one-twelfth of an inch long, and not more than one thirty-second of an inch wide, being broadest at the head. They vary from bright to pale green in color (Fig. 10). The adult insects go thru the winter sheltered in clump-forming grasses, under leaves in orchards and woodlands, and other sheltered places. They fly about early in the spring as soon as vegetation starts, and feed by sucking the sap of various weeds and grasses. They migrate to potato fields usually about the time the plants are 4 to 8 inches high. They feed on the sap of the potato plants, and very shortly the females start laying their eggs. These are inserted in the larger veins and stem of the leaf. The eggs soon hatch into very small, pale green, active nymphs just large enough to be seen when they first emerge. These nymphs cannot fly, as do the adult leafhoppers, but make up for their lack of wings by their nimbleness. They will run backwards or sideways as readily as forward. They grow for three weeks or more, shedding their skins several times, and finally acquire wings on becoming adults. There are three or four broods of this leafhopper each year in Illinois. They feed on a variety of other plants, including numerous weeds, and are injurious to beans, soybeans, alfalfa, red clover, and several cultivated plants.

Control. As leafhoppers are sucking insects, the poisons used for controlling the Colorado potato beetle and other leaf chewers have no effect upon them. Fortunately for the potato grower, however, bordeaux mixture, the standard fungicide for potato diseases, is very repellent to these insects, and where thoroly applied, it will also kill many of the young nymphs and prevent the hatching of the eggs. The best means of controlling the potato leafhopper is to spray or dust the vines thoroly with bordeaux mixture, giving the first application at the time when the vines are about 6 to 8 inches high, and applying 3 or



FIG. 10.—ADULT POTATO LEAFHOPPER, MUCH ENLARGED

This insect, one of the most common and most destructive potato insects in the United States, is so small that it is usually not noticed on the potato leaves. The short line on the left shows its actual length. Bordeaux mixture properly applied gives good control.

4 other sprays or dusts at intervals of one week to ten days. This schedule should be used on both early and late potatoes. In spraying or dusting it is necessary to coat the under as well as the upper sides of the leaves. Applying the bordeaux with a sprinkling can to the tops of the leaves *will not* control the potato leafhopper. Commercially prepared bordeaux may be used, but is not quite as effective as the freshly mixed homemade bordeaux.

Fenton and Hartzell in Iowa have found a considerable difference in the effect of leafhopper injury on different varieties of potatoes.* Their statement of the results of experiments on this point is as follows: "Comparative tolerance for the disease was shown to be greatest in potatoes of the Rural New Yorker group, followed by Green Mountain, Irish Cobbler, Early Ohio, and Triumph, in the order listed, the last named being the most susceptible to attacks of leafhoppers."

Potato Flea Beetle

(*Epitrix cucumeris*)

The potato flea beetle probably ranks third in importance as an insect pest of potatoes in Illinois. These little gray-black beetles



FIG. 11.—POTATO FLEA BEETLE

During springs that are favorable to this insect the beetle, smaller than a pin head, eats small holes in the potato leaves. It does most of its damage while the plants are 4 to 6 inches high. Bordeaux mixture is a standard control spray.

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(Fig. 11), smaller than the head of a pin, go thru the winter in the full-grown stage in sheltered places. They come out early in the spring and fly about, feeding on several different plants but largely on those belonging to the same family as the potato. When the potatoes are first coming thru the ground, these beetles feed on the surface of the leaves, eating out little holes and giving the leaf much the appearance of having been frequently punched with a large pin. When abundant, they stunt the young plants, often causing the foliage to develop in an abnormal way. The female beetles lay their eggs in the soil around the potato plants, and the very small young grubs feed on vegetable matter in the soil, the underground parts of the potato stems, the old planted piece of the potato in the ground, and sometimes on the newly forming potatoes. When very abundant, they may injure the tubers, giving them a roughened, scabby appearance. There are two or more broods of the insect each season.

Control. The potato flea beetle is not easily poisoned by arsenate of lead. The best method of control is the same as that recommended for the potato leafhopper. Vines that are thoroly sprayed with bordeaux on both the upper and under sides of the leaves will not be seriously injured. If flea beetles are abundant, it is necessary to apply the bordeaux when the potato plants are not more than 3 to 4 inches high since it is in the early stages of plant growth that they are most destructive.

White Grubs

(*Phyllophaga*)

Potatoes, especially in northern Illinois, are frequently injured by grub worms, the young of "June bugs," or May beetles. These beetles lay their eggs by preference in sod or in land in crops if there is a considerable growth of grass. They spend three years of their life in the soil, going down below the frost line each winter and coming up again in the spring. The insects have a regular period of abundance, the most serious injury occurring during the second year of the grubs' existence in the soil. In northern Illinois an abundance of grubs can be expected in 1930, 1933, and at regular three-year periods thereafter. Since the eggs are laid mainly in sod land, it is best to avoid planting potatoes on such land in years when the grub worms are abundant. There are some grubs present every year, however, and where they are found abundant when plowing, the ground should not be planted to potatoes. In gardens they are more apt to be plentiful where poplar, willow, elm, or oak trees are growing in close proximity, as it is on the foliage of these trees that most species of May beetles feed, and the females are more apt to lay their eggs close to the trees where they have been feeding.

Control. There is no seed treatment which is effective in controlling white grubs. Clover sod is very seldom infested with grubs, and the same is true of second-year corn ground, soybean ground, or alfalfa sod. Early fall plowing is of some value in ridding soil of white grubs. If the next year's potato ground can be pastured to hogs during the late summer, nearly all the grubs may be cleaned out.

Wireworms

(*Elateridae*)

The potato, as well as most garden and field crops, is subject to injury by smooth, brown, hard-bodied worms from $\frac{1}{2}$ to $2\frac{1}{2}$ inches long. These worms are the young of the snap, or click, beetles.

There are a number of species of these beetles in Illinois. The adults of most of them prefer, like the adults of the white grubs, to

lay their eggs in sod ground or ground covered with a heavy plant growth. The worms on hatching spend several years in the ground, this period varying with the species, but it is usually from three to five years. Potatoes grown in a field the second year from sod are usually the most seriously injured by these worms.

Control. There is no effective method of ridding the ground of these pests. The only practical way to avoid damage on soils where wireworms are abundant is to grow crops not subject to serious injury, such as small grains or soybeans. A rotation should be practiced that does not have potatoes on a field the second year from sod. When potatoes are persistently attacked by wireworms, it is likely to be due to poor soil drainage.

Potato Aphis

(*Macrosiphum solanifolii*)

Practically all our cultivated plants are subject to infestation by one or more kinds of aphids, or plant lice. Two or three different aphids are of importance on the potato, the most serious one being the potato aphis. This insect is one of the largest plant lice that we commonly encounter on our field crops. It is much more destructive in the East than in Illinois. It feeds mainly on the undersides of the leaves, and on the stems, and stalks, sucking the sap. Studies of the insect in Maine show that it passes the winter in the egg stage on rose bushes. It can generally be found in potato fields in Illinois, but is held in check by adverse weather conditions and by a number of insect enemies.

Control. Potato aphids may be controlled by spraying with nicotine sulfate, or free nicotine, and soap solution, used at the rate of 2 pounds of soap to each 50 gallons of water, and $\frac{1}{2}$ pint of 40-percent nicotine sulfate to 50 gallons of water. Stomach poisons such as arsenate of lead or paris green are of no value against aphids. Careful spraying must be done, as it is only those aphids that are hit by the spray that will be killed. Special care must be taken to spray the undersides of the leaves. Dusting thoroly with a 4-percent nicotine dust will kill the aphids. Potatoes that are regularly sprayed with bordeaux mixture are not so subject to aphid injury as those that have not been so sprayed.

Blister Beetles

(*Meloidae*)

Sometimes in going into a potato field, one will encounter numbers of rather large clumsy beetles feeding on the potato foliage. Some of these beetles may be a bluish-black in color, others black with gray margins on the wings, others nearly gray, and still others striped with a dull yellow and brown. They vary in size according to the color,

which really indicates different species of the same genus. The larger species are fully an inch in length (Fig. 12). If these insects are crushed on one's skin, they will cause a blister, and it is because of this peculiarity that they get their name of blister beetles. They are also called "old-fashioned potato beetles," "Long Johns," and several other names. The female beetles lay their eggs in the fall in the ground. The young, which hatch a little later, feed largely on the eggs of grasshoppers, so these insects are of some benefit to man; only the adult beetles feed on the potato. The adult beetles are also fond of a large number of other plants, including nearly everything that is grown in the garden.

Control. Blister beetles are very difficult to poison but they may be prevented from feeding on the potato or other plants by thoroly spraying with bordeaux mixture. If bordeaux is not available, spray with sodium fluosilicate at the rate of 2 pounds to 50 gallons of water, or dust the potatoes with the latter chemical. Potatoes sprayed for leafhopper control will not be badly injured by blister beetles.

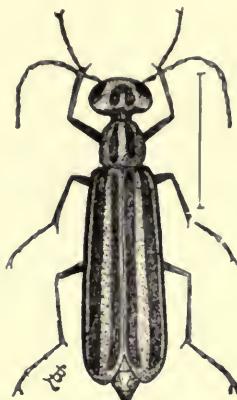


FIG. 12.—FULL-GROWN BLISTER BEETLE

This is one of several kinds of blister beetles to be found feeding on potatoes. Spraying with bordeaux mixture or spraying or dusting with sodium fluosilicate will control this pest.

Potato Stalk Borer (*Trichobaris trinotata*)

When potato vines are somewhat stunted and misshapen, with the leaves brown and undersized, an examination may show the presence of small, curved, whitish grubs boring inside the larger stems. These grubs are the larvae of the potato stalk weevil. The insect is not generally a serious pest in Illinois but occasionally becomes abundant.

Control. The best remedy is to gather and carefully burn all infested vines as soon as the potatoes are dug. Most of the weevils will be destroyed in this way.

Common Stalk Borer (*Papaipema Sp.*)

Potato vines are also sometimes found infested by brown worms having a white stripe running the length of the body along the back

with two broken stripes on each side. This insect is the common stalk borer (Fig. 13), and feeds on a large number of plants, including corn, small grains, beans, and potatoes. In its adult stage it is a grayish moth which lays its eggs in the early fall around the grassy margins of the field, roadsides, and in like situations. The insect goes thru the winter in the egg stage.

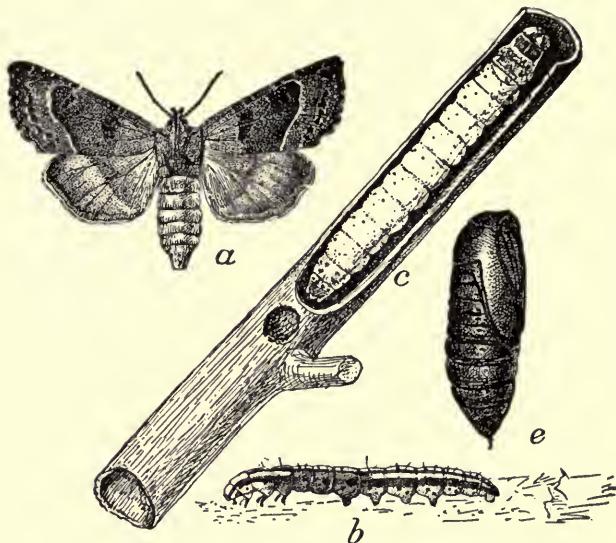


FIG. 13.—COMMON STALK BORER

(a) The moth or adult borer; (b and c) caterpillar or borer; (e) pupa or changing stage. Note the broken white lines on the back of the partly grown caterpillar in b. To control this insect, field margins must be cleaned up or burned in the winter or early spring.

Control. Cleaning up field margins, if possible burning them during the winter or early spring, is the only means of controlling this insect.

Potato Seed Maggot

(*Phorbia fusciceps*)

Occasionally in southern Illinois the cut pieces of potatoes when planted will fail to sprout properly, and on digging these up to discover the cause they will be found covered with small, whitish maggots, a little smaller than those of the house fly (Fig. 14). These maggots are the young of a medium-sized fly which passes the winter in a brown resting case in the ground, coming out in the early spring and laying its eggs on decaying vegetable matter in the soil. The flies are attracted to soil containing an abundance of decaying vegetable

matter; sometimes, however, they apparently lay eggs directly in the planted pieces of potato. The insect is neither abundant nor very destructive in this state.

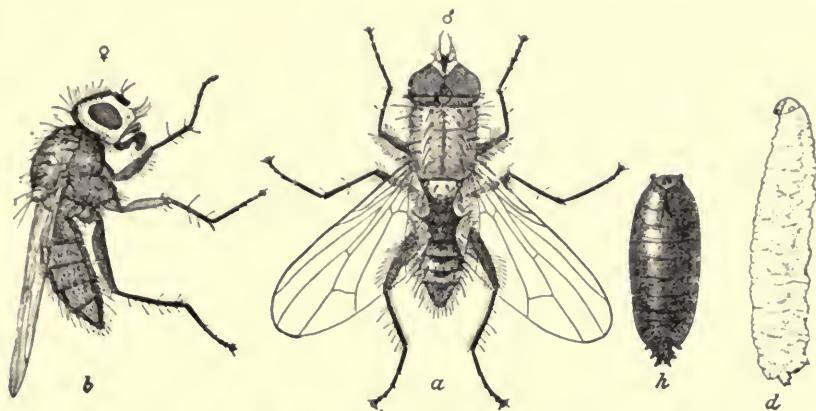


FIG. 14.—SEEDCORN MAGGOT IN DIFFERENT STAGES OF GROWTH

This insect occasionally causes trouble in southern Illinois. The injury by this pest is all done by the larva or maggot (*d*) as it burrows in the planted potato pieces. The adult male is shown at *a*, and the female at *b*; the pupa, or changing stage, at *h*.

Control. The best control measure consists of late planting, using good seed that will promote a rapid growth of the plants. Shallow planting is also of some value in combating this insect.

POTATO SPRAYING EXPERIMENTS

In order to find the best sprays to combat potato insects and diseases in Illinois, a number of experiments have been carried on at different points in the state. In the main, these experiments have consisted of spraying and dusting with arsenate of lead or paris green alone, a practice that is quite generally followed, especially among the smaller growers, and comparing this treatment with arsenate of lead and bordeaux mixture. In all cases, treatment was started when the plants were about 6 to 8 inches high and the applications were made as indicated in Table 7.

The results of these experiments show very conclusively that the addition of bordeaux mixture, either as a spray or as a dust, to the arsenate of lead, on the average increases the yields approximately one-third. In years when potato leafhoppers and potato blight are abundant, the yields are increased as much as 100 percent.

TABLE 7.—RESULTS OF SPRAYING EXPERIMENTS FOR CONTROL OF POTATO INSECTS AND DISEASES AT DIFFERENT POINTS IN ILLINOIS

Year	Location of plots	Materials used	Times sprayed and length of interval		Yield per acre <i>bu.</i>	Gain per acre <i>bu.</i>	Percentage gain
1921	Urbana.....	Bord. 4-4-50, ars. lead...	4 (7-day).....	106.7	8.8	8.9	...
		Check—ars. lead only.....	.....	97.9	.....	.....	...
1922	Urbana.....	Bord. 4-4-50, ars. lead...	4 (7-day).....	97.5	30.8	46.1	...
		Bord. 4-4-50, ars. lead...	4 (10-day).....	94.9	28.2	42.2	...
		Check—ars. lead only.....	.....	66.7	.....	.....	...
1922	Arlington Heights.....	Bord. 4-4-50, ars. lead...	5 (7-day).....	172.6	56.6	48.9	...
		Bord. 4-4-50, ars. lead...	4 (10-day).....	154.2	38.2	32.9	...
		Check—ars. lead only.....	.....	116.0	.....	.....	...
1922	Blue Island.....	Bord. 4-4-50, ars. lead...	7 (7-day).....	104.0	52.0	100.0	...
		Bord. 4-4-50, ars. lead...	5 (10-day).....	48.0	-4.0	-7.7	...
		Check—ars. lead only.....	.....	52.0	.....	.....	...
1922	Blue Island (hand treated plots).....	Bord. 4-4-50, ars. lead and easem...	6 (7-day).....	98.8	46.8	90.0	...
		Commercial bordeaux.....	6 (7-day).....	102.0	50.0	96.1	...
		Bord. nicotine dust, ars. lead.....	6 (7-day).....	112.0	60.0	115.4	...
		Bord. nicotine dust, ars. lead.....	5 (10-day).....	88.0	36.0	69.2	...
		Check—ars. lead only.....	.....	80.0	28.0	53.8	...
1922	Madison county.....	Bord. 4-4-50, ars. lead...	3 (10-day).....	225.0	38.0	20.3	...
		Bord. 4-4-50, ars. lead...	3 (10-day).....	195.0	8.0	4.2	...
		Check—ars. lead only.....	.....	187.0	.....	.....	...
1923	Urbana.....	Bord. 4-4-50 ars. lead...	4 (7-day).....	119.3	4.5	4.7	...
		Green copper dust, ars. lead...	4 (7-day).....	149.1	35.2	30.9	...
		Check—ars. lead only.....	.....	113.9	.....	.....	...
1923	Arlington Heights (Early potatoes).....	Bord. 4-4-50, ars. lead...	5 (7-day).....	167.1	96.4	136.3	...
		Green copper dust, ars. lead...	5 (7-day).....	114.3	43.6	61.6	...
		Bord. 4-4-50, ars. lead...	4 (7-day).....	159.9	89.2	126.1	...
		Check—ars. lead only.....	.....	70.7	.....	.....	...
		(Late potatoes).....	.....	.....	.....	.....	...
1923	St. Clair county.....	Bord. 4-4-50, ars. lead...	5 (7-day).....	263.7	148.6	129.1	...
		Commercial bordeaux...	4 (7-day).....	224.4	109.3	94.9	...
		Check—ars. lead only.....	.....	115.1	.....	.....	...
		Bord. 4-0-50 ars. lead...	6 (7-day).....	138.0	40.5	41.5	...
		Commercial bordeaux...	6 (7-day).....	130.0	52.5	53.8	...
		Check—ars. lead only.....	.....	97.5	.....	.....	...
1923	East Dubuque.....	Bord. 4-4-50, ars. lead...	5 (7-day).....	231.0	14.0	6.4	...
		Check—ars. lead only.....	.....	217.0	.....	.....	...
1925	St. Clair county.....	Bord. 4-0-50, ars. lead...	4 (10-day).....	125.0	35.0	38.8	...
		Check—ars. lead only.....	.....	90.0	.....	.....	...

The data further indicate that bordeaux mixture applied at intervals of 7 days gives larger gains than when applied at 10-day intervals.

Regional differences in the gains resulting from spraying, as shown by this experiment, are large. In the northern part of the state the average gain per acre for the use of bordeaux mixture with arsenate of lead, over arsenate of lead alone, is 61.7 bushels; for the central part, 19.7 bushels; and for the southern part, 34.5 bushels.

Spraying or Dusting Schedule for Illinois Potatoes

Fortunately for the potato grower it is possible to control many of the diseases and insects that commonly occur on the potato in Illinois by three to five applications of bordeaux spray or bordeaux dust with arsenate of lead added to the first two or three applications. The spray is easy to make and cheap, costing only about one cent a gallon where it is used alone, and one and one-half cents when arsenate of lead is added. Commercial bordeaux dust, which contains poison, costs about 9 to 15 cents a pound.

The experiments carried on during the past eight years have shown, in general, that most insects and diseases attacking the potato foliage can be controlled by three to five applications of 4-6-50 bordeaux, with arsenate of lead added at the rate of 2 pounds to 50 gallons of the mixture when the Colorado potato beetle is abundant. In years when flea beetles are numerous, the spraying should be started when the plants are 4 inches tall; where these insects are not troublesome, it should be started when the plants are 8 inches high. Three or four subsequent sprays or dustings should be applied at intervals of 7 to 10 days.

To be effective, the spray must be applied under pressure to both the upper and *under* sides of the leaves. A pressure of 150 pounds should be maintained on the sprayer, and at least 100 gallons should be applied per acre. If dust is used, apply with a field duster, putting on 20 to 25 pounds an acre. If the potato aphis is causing injury, add one-half pint of 40-percent nicotine sulfate to each 50 gallons of the bordeaux mixture. Such a spray schedule will cost from \$10 to \$12 an acre for the season, including labor and materials. In the experimental work there has been an average increase of over 40 bushels an acre where this spray schedule has been followed, and in some seasons the increase in yield has been much larger.

First Application. The first application of spray or dust should be made when the vines are 6 to 8 inches tall. If the spray is used, the application should consist of 4-6-50 bordeaux mixture and 2 pounds of arsenate of lead to each 50 gallons of water. The arsenate of lead is to be added only when flea beetles or the Colorado potato

beetles are present in such numbers that they are causing injury to the vines. The bordeaux is important in the control of blight.

Second Application. The second application of spray or dust should be made 7 to 10 days after the first. It consists of the same materials. This application is for blight and the hatching leafhoppers and is generally the most important for the control of the Colorado potato beetle.

Third Application. The third application should be made 7 to 10 days after the second, using the same materials. This is for blight and potato leafhopper. If the two previous sprays have been thoroly applied, it will not be necessary to use arsenate of lead in this application.

Later Applications. It will usually be advisable to give a fourth spraying or dusting, using the bordeaux mixture alone, 7 to 10 days after the third application. If the vines are still in a strong, growing condition 10 days later, a fifth application should be applied at that time. This schedule will apply equally well to both early and late potatoes.

Directions for Making Bordeaux Mixture

There are several good commercial bordeaux dusts on the market. Since these dusts cannot be easily prepared by the grower a commercial preparation may be purchased when only a small quantity of bordeaux is required; this should be diluted according to the directions of the manufacturer. When any considerable amount of spraying is to be done, however, bordeaux is ordinarily prepared according to the following formula:

4 pounds copper sulfate (blue vitriol)

6 pounds hydrated lime

- or 4 pounds lump (stone) lime*

50 gallons water

(*Only the highest grade of lime should be used.)

Directions for Mixing. If stone lime is used, two stock solutions must be prepared, one of lime and one of copper sulfate. Each should be made up at the rate of 1 pound in 1 gallon of solution.

Place the required amount of copper sulfate in a burlap bag and suspend the bag in a wooden or stone vessel just at the surface of the water, which has been measured into the vessel. Do not stir until the copper sulfate has dissolved.

Slake the lime carefully with just enough water to prevent the formation of a dry powder. After the violent boiling is over, add a small amount of water and work the whole to a paste or cream and allow to cool. Dilute this paste so there will be 1 pound of lime to each gallon of solution.

If hydrated lime is used, the amount required for each sprayerful should be stirred into enough water to make a thin paste.

The copper sulfate and lime are now ready for mixing. First, partly fill the sprayer with water, then add the lime or 6 pounds of hydrated lime in paste form for each 50 gallons of spray. Continue filling the sprayer with water until it is about two-thirds full. With the agitator going, add 4 gallons of copper sulfate stock solution for every 50 gallons of spray. Then add water to make up the final volume.

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Getting Better Potato Yields

1. Potatoes can be made a more profitable crop in Illinois with the adoption of better cultural practices. The greatest natural hazard is drouth. The most serious handicaps that can be controlled are insect pests and potato diseases. (Pages 243-244)

2. Bordeaux mixture added, either as a spray or as a dust, to arsenate of lead will increase yields on the average about one-third. When insects and diseases are very abundant, yields may be increased 50 to 100 percent by such a spray. (Pages 279-283)

3. Northern-grown seed potatoes are decidedly superior to home-grown. As an average of 50 trials extending over twelve years, northern-grown seed yielded 11.8 percent more than home-grown seed. (Page 257)

4. Cobbler and Early Ohio varieties are recommended as the most satisfactory early potatoes. Carman No. 3 is an outstanding late variety. (Pages 253-256)

5. Potatoes are tolerant to acid soils. Where legumes will grow satisfactorily without applications of limestone, it is not necessary to apply limestone for potatoes. (Pages 249-250)

6. Barnyard manure gives the most consistent and largest increases of any fertilizer. (Page 251)

7. Where heavy fertilization with manure is impracticable, it is recommended that the field be tested to determine its need for phosphorus. Where phosphorus is deficient, applications should be made in the form that will give the largest net returns. (Pages 250-251)

8. Most soils of the state have been found to contain sufficient potassium for field crops. Potassium is likely to be deficient only on sandy, peaty, and clay soils low in active organic matter. (Page 252)

9. The use of commercial fertilizer is to be considered only where it is clear that profitable increases in yield cannot be obtained in more economical ways. (Pages 252-253)





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